Meeting the Grand Challenge of Protecting Astronaut's Health: Electrostatic Active Space Radiation Shielding for Deep Space Missions

Completed Technology Project (2011 - 2012)

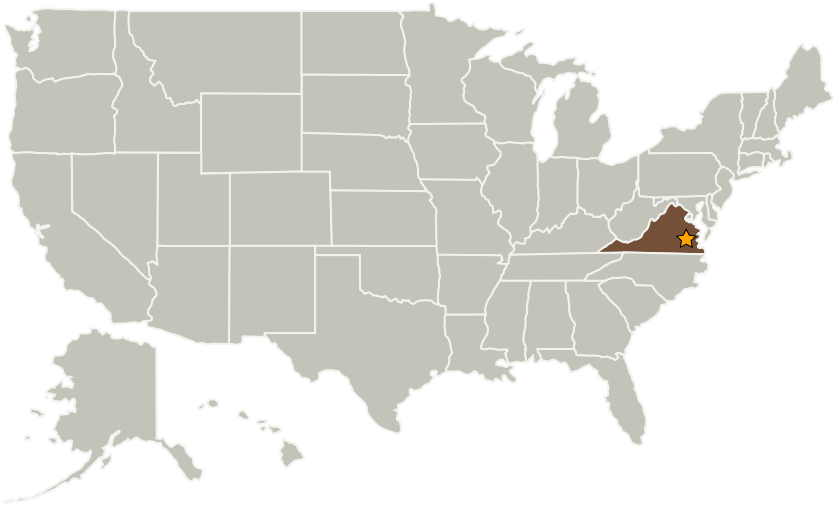
Project Introduction

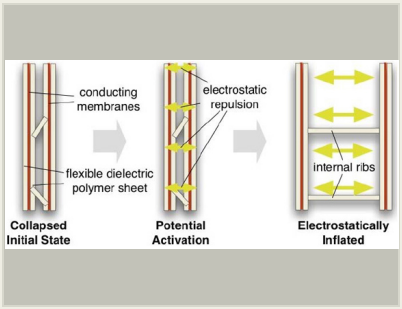
This study will seek to test and validate an electrostatic gossamer structure to provide radiation shielding. It will provide guidelines for energy requirements, dose reduction and deflection efficiencies, and effective enhancements of dual electrostatic-passive (material) shielding technologies, and 'engineering-feasible' architectures.

Anticipated Benefits

The biggest advantage of using active radiation shielding is the significant reduction of biological risks, often unknown, that are always present with the use of bulk material shielding in manned spacecraft due to primary space and secondary, material shield generated radiation.

Primary U.S. Work Locations and Key Partners





Project Image Meeting the Grand Challenge of Protecting Astronaut's Health: Electrostatic Active Space Radiation Shielding for Deep Space Missions

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Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Old Dominion University Research Foundation(ODURF)	Supporting Organization	Academia	Norfolk, Virginia
University of Colorado Boulder	Supporting Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations
Virginia

Project Transitions

September 2011: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

NASA Innovative Advanced Concepts

Project Management

Program Director:

Jason E Derleth

Program Manager:

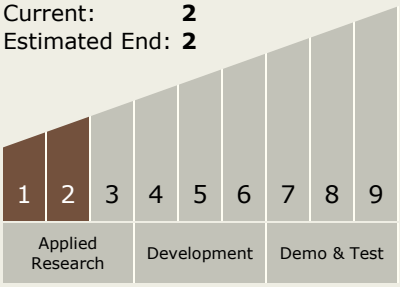
Eric A Eberly

Principal Investigator:

Ram K Tripathi

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



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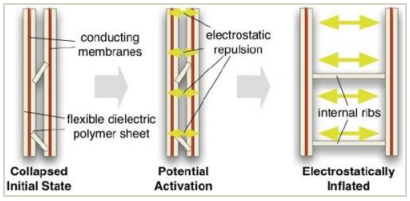
September 2012: Closed out

Closeout Summary: Our final report summarizes research performed on the use of electrostatically inflated membrane structures for active radiation shielding. In this study different innovative configurations were explored to design an optimum active shielding. The study found small membrane vibrations during charge bombardment of an EIMS. Elimination of several potential vibration sources led to the hypothesis that the vibration is a result of local surface charge density variations causes by the charge flux. Within this project, charge deflection and shielding experiments were performed. Plots were presented to describe both the shielding capabilities and the charge deflection patterns around a charged membrane, showing the capability to shield low-energy electrons with EIMS. Also, different membrane materials were investigated, including membrane of much smaller thickness. Too thin materials presented challenges in vacuum preparation and also for rapid charging of membranes. Results from the power requirements study show that the EIMS power requirement becomes increasingly more challenging as the spacecraft voltage is increased. As a result, the emphasis is on the deflection of charges away from the spacecraft rather than totally stopping them. This significantly alleviates the initial power requirements. It was found, though, that SPE and GCR do not affect the nominal power level required for an electrostatic radiation shielding system. During this study electrostatic active radiation shielding technology has significantly been advanced to a much higher maturity and/or TRL level than ever before and has moved a step closer to reality. With modest technological development(s) active shielding is emerging to be a viable option.

Images



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Project Image Meeting the Grand Challenge of Protecting Astronaut's Health: Electrostatic Active Space Radiation Shielding for Deep Space Missions
(https://techport.nasa.gov/image/102213)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.5 Radiation
    - TX06.5.3 Protection Systems

Target Destination

Mars